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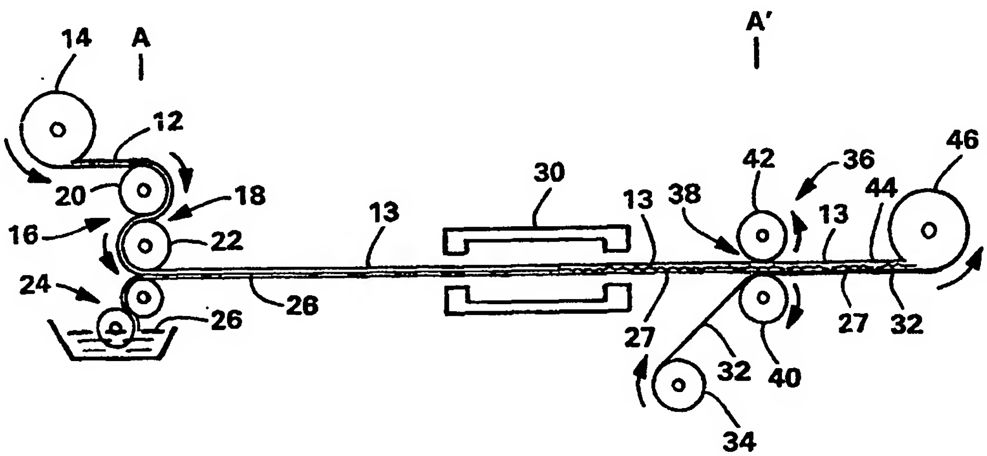

(57) Abstract

A method of forming a stretchable composite by applying a polymeric precursor (26), such as a latex or thermoset elastomer, to a neckable material (12) either prior to or after neck-stretching the material, then treating the polymeric precursor (26) on the necked material to form a polymeric tie layer (27). An elastic sheet (32) is bonded to the tie layer and necked-stretched material thereby forming an elastic necked-bonded laminate (44).

ELASTIC NECKED-BONDED MATERIALS AND METHODS OF FORMING THE SAME

FIELD OF THE INVENTION

The present invention relates to methods of forming elasticized materials. More particularly, the present invention relates to elastic neck-bonded laminates, and methods of making the same.

BACKGROUND

Polymeric nonwoven webs formed by nonwoven extrusion processes such as, for example, meltblowing processes and spunbonding processes may be manufactured into products and components of products so inexpensively that the products could be viewed as disposable after only one or a few uses. Examples of such products include diapers, tissues, wipes, garments, mattress pads and feminine care products. There exists a continuing need for improved materials which are elastic, resilient, and flexible while still having a pleasing feel. A problem in fulfilling this need is that commercially viable elastic materials often feel rubbery.

The unpleasant tactile properties of elastic materials may be avoided by forming a laminate comprising an elastic sheet with one or more nonelastic sheets which have a soft feel. However, nonwoven webs formed from nonelastic polymers having improved tactile properties such as, for example, polypropylene are generally considered nonelastic. The lack of elasticity usually restricts these nonwoven fabrics to applications where elasticity is not required. Nevertheless, laminates of elastic and nonelastic materials have been made by bonding the nonelastic material to the elastic material in a manner that allows the laminate to stretch and recover yet which retains the desirable tactile properties of the nonelastic material. Elastic laminates, comprising an elastic sheet and a soft nonelastic material, are typically incorporated into products such that the soft material will contact a persons skin or forms the outermost portion of the product.

In one such laminate, a nonelastic material is joined to an elastic material while the elastic material is in a stretched condition so that when the elastic material is relaxed, the nonelastic material gathers between the locations where it is bonded to the elastic material. The resulting composite elastic material is readily stretchable to the extent that

the nonelastic material gathered between the bond locations allows the elastic material to elongate. An example of this type of composite material is disclosed, for example, by U.S. Patent No. 4,720,415 to Vander Wielen et al.

Another elastic laminate known in the art includes those conventionally referred to as "neck-bonded" materials. Necked-bonded materials are generally fabricated by bonding an elastic member to a non-elastic member while the non-elastic member is narrowed or necked. Neck-bonded laminates provide a material which is stretchable in the necked direction, the necked direction is most commonly also the cross-machine direction. Examples of neck-bonded laminates are described in commonly assigned U.S. Patent Nos. 5,226,992 and 5,336,545 both to Morman. In addition, "reversibly necked materials" include materials which are stretchable to about the pre-necked dimensions and which, upon release of the stretching force, substantially recover to the necked dimensions unaided by additional materials. Such materials are typically formed by necking the material and treating the necked material, such as by heating and cooling the material, in order to impart memory of the necked dimensions to the material. Reversibly necked materials and methods of forming the same are disclosed in commonly assigned U.S. Patent No. 4,965,122 to Morman.

Due to the nature of the methods of making elastic laminates, such as those described above, there exists a variety of elastic materials having the requisite characteristics for use in forming the elastic laminate structure. Similarly, there likewise exists a variety of neckable materials which are suitable for use in forming the elastic laminate structure. However, due to the variety of elastic and neckable materials potentially used to form elastic laminates there exist certain combinations of elastic and neckable materials which, although having excellent physical characteristics, do not adhere well to the other layers of the laminate. Thus, there exists a need for necked bonded laminates, and methods of producing the same, having improved integrity as well as the desired tactile and elastic properties.

DEFINITIONS

As used herein the term "spunbonded fibers" refers to small diameter fibers which are formed by extruding molten thermoplastic material as filaments from a plurality of fine, usually circular capillaries of a spinneret with the diameter of the extruded molten filaments then being rapidly reduced as described in, for example, in U.S. Patent 4,340,563 to Appel et al., and U.S. Patent 3,692,618 to Dorschner et al., U.S. Patent

3,802,817 to Matsuki et al., U.S. Patents 3,338,992 and 3,341,394 to Kinney, U.S. Patent 3,502,763 to Hartman; U.S. Patent 3,542,615 to Dobo et al and U.S. Patent No. 5,382,400 to Pike et al. Spunbond fibers are then usually cooled and solidified so they are not tacky when they are deposited onto a collecting surface. Spunbond fibers are generally continuous and have average diameters (from a sample of at least 10) larger than 7 microns, more particularly, between about 10 and 40 microns.

As used herein the term "meltblown fibers" refers to fibers formed by extruding a molten thermoplastic material through a plurality of fine, usually circular, die capillaries as molten threads or filaments into converging high velocity, usually hot, gas (e.g. air) streams which attenuate the filaments of molten thermoplastic material to reduce their diameter, which may be to microfiber diameter. Thereafter, the meltblown fibers are cooled and carried by the high velocity gas stream and are deposited on a collecting surface to form a web of randomly disbursed meltblown fibers. Such a process is disclosed, for example, in U.S. Patent 3,849,241 to Butin et al.

As used herein "multilayer laminate" refers to a laminate having at least two layers with one of which being a nonwoven web. For example, some of the layers can be spunbond and some meltblown such as a spunbond/meltblown/spunbond (SMS) laminate and others as disclosed in U.S. Patent 4,041,203 to Brock et al., U.S. Patent 5,169,706 to Collier, et al, U.S. Patent 5,145,727 to Potts et al., U.S. Patent 5,178,931 to Perkins et al. and U.S. Patent 5,188,885 to Timmons et al. Such a laminate may be made by sequentially depositing onto a moving forming belt first a spunbond fiber layer, then a meltblown fiber layer and last another spunbond fiber layer and then bonding to form a laminate. Alternatively, the fabric layers may be made individually, collected in rolls, and combined in a separate bonding step. Such fabrics usually have a basis weight of from about 0.1 to about 12 ounces/yd.^{2} (about 3.4 to about 400 g/m^2), or more particularly from about 0.75 to about 3 ounces/yd.^{2} (about 25 to about 100 g/m^2). Multilayer laminates may also have various numbers of meltblown layers or multiple spunbond layers in many different configurations and may include other materials like woven layers, films or coform materials.

As used herein, the term "machine direction" or MD refers to the direction in which the neckable material is produced. The term "cross machine direction" or CD refers to the direction generally perpendicular to the MD.

As used herein the term "microfibers" refers to small diameter fibers having an average diameter not greater than about 100 microns, for example, having an average

diameter of from about 0.5 microns to about 50 microns, or more particularly, microfibers may have an average diameter of from about 2 microns to about 40 microns.

As used herein, "ultrasonic bonding" refers to a process performed, for example, by passing the fabric between a sonic horn and anvil roll as illustrated in U.S. Patent 4,374,888 to Bornslaeger.

As used herein "thermal point bonding" involves passing a fabric or web of fibers to be bonded between a heated bonding assembly, such as a heated calender roll and a heated anvil roll. The calender roll is usually, though not always, patterned in some way so that the entire fabric is not bonded across its entire surface, and the anvil roll is usually smooth. As a result, various patterns for calender rolls have been developed for functional as well as aesthetic reasons. One example of a pattern is the Hansen Pennings or "HP" pattern with about a 30% bond area with about 200 bonds/square inch as taught in U.S. Patent 3,855,046 to Hansen and Pennings. A new HP pattern roll has square point or pin bonding areas wherein each pin has a side dimension of 0.038 inches (0.965 mm), a spacing of 0.070 inches (1.778 mm) between pins, and a depth of bonding of 0.023 inches (0.584 mm). The resulting pattern has a bonded area of about 29.5%. Another typical point bonding pattern is the expanded Hansen Pennings or "EHP" bond pattern which, when new, produces a 15% bond area with a square pin having a side dimension of 0.037 inches (0.94 mm), a pin spacing of 0.097 inches (2.464 mm) and a depth of 0.039 inches (0.991 mm). Another typical point bonding pattern designated "714" has square pin bonding areas wherein each pin has a side dimension of 0.023 inches, a spacing of 0.062 inches (1.575 mm) between pins, and a depth of bonding of 0.033 inches (0.838 mm) when new. The resulting pattern has a bonded area of about 15%. Yet another common pattern is the C-Star pattern which has a bond area of about 16.9% when new. The C-Star pattern has a cross-directional bar or "corduroy" design interrupted by shooting stars. Other common patterns include a diamond pattern with repeating and slightly offset diamonds with about a 16% bond area and a wire weave pattern looking similar to a window screen, with about a 19% bond area. Typically, the percent bonding area is less than 50% of the area of the laminate and desirably varies from around 10% to around 30% of the area of the laminate.

The term "elastic" as used herein refers to any material which, upon application of a biasing force, is elongatable to a stretched, biased length which is at least about 160 percent of its relaxed unbiased length, and which, will recover at least 55 percent of its elongation upon release of the elongating force. A hypothetical example would be a one (1) inch sample of a material which is elongatable to at least 1.60 inches and which,

upon being elongated to 1.60 inches and released, will recover to a length of not more than 1.27 inches. Many elastic materials may be stretched by much more than 60 percent of their relaxed length, for example, 100 percent or more, and many of these will recover to substantially their original relaxed length, for example, to within 105 percent of their original relaxed length, upon release of the stretching force.

As used herein, the term "nonelastic" refers to any material which does not fall within the definition of "elastic," above.

As used herein, the term "recover" refers to a retraction of a stretched material upon termination of a biasing force following stretching of the material by application of the biasing force. For example, if a material having a relaxed, unbiased length of one (1) inch is elongated 60 percent by stretching to a length of 1.6 inches the material would be elongated 60 percent (0.6 inch) and would have a stretched length that is 160 percent of its relaxed length. If this exemplary stretched material contracted, that is recovered to a length of one and two tenths (1.2) inches after release of the biasing and stretching force, the material would have recovered about 66 percent (0.4 inch) of its 0.6 inch elongation. Recovery may be expressed as [(maximum stretch length - final sample length)/(maximum stretch length - initial sample length)] X 100.

As used herein, the terms "necking" or "neck stretching" interchangeably refer to a method of elongating a nonwoven fabric, e.g. in the machine direction, to reduce its width in a direction perpendicular to the direction of elongation in a controlled manner to a desired amount. The controlled stretching and necking may take place under cool, room temperature or greater temperatures and is limited to an increase in overall dimension in the direction being stretched up to the elongation required to break the fabric. When relaxed, the web retracts toward its original dimensions. Such a process is disclosed, for example, in U.S. Patent No. 4,443,513 to Meitner et al.; U.S. Patent Nos. 4,965,122, 4,981,747 and 5,114,781 to Morman and U.S. Patent No. 5,244,482 to Hassenboehler Jr. et al.

As used herein, the term "neckable material" refers to any material which can be necked; that is a material that can be constricted in at least one dimension by processes such as, for example, drawing.

As used herein, the term "necked material" refers to any material which has been constricted in at least one dimension by processes such as, for example, drawing.

As used herein the term "reversibly necked material" refers to a material which is capable of being stretched in the necked direction to its original pre-necked dimensions and, upon removal of the stretching force, substantially returning to the necked

dimensions unaided, such as by an elastomeric sheet. Typically reversibly necked materials include necked materials which have been heated and cooled while under a tensioning force. The heating and cooling of the material while necked serves to impart memory of the material's necked condition.

As used herein, the term "percent neckdown" refers to the ratio determined by measuring the difference between the un-necked dimension and the necked dimension of the neckable material and then dividing that difference by the un-necked dimension of the neckable material. The ratio is then multiplied by 100.

As used herein, the term "sheet" means either a film, foam or a nonwoven web.

As used herein the term "layer" refers to a polymeric material which, when supported on a substrate, may be either continuous, e.g. a film, or discontinuous, e.g. a repeating or random pattern of discrete regions.

As used herein, the term "elastic necked-bonded laminate" refers to a material having an elastic layer joined to a necked material. The elastic material may be joined to the necked material at intermittent points or regions or may provide complete coverage of the necked material. The elastic necked-bonded laminate is elastic in a direction generally parallel to the direction of neckdown of the necked material and may include one or more layers. For example, the elastic necked-bonded laminate may have necked material joined to both of its sides so that a three-layer composite elastic necked-bonded material is formed having a structure of necked material/elastic material/necked material. Additional layers of elastic and/or necked material may be added. In addition, numerous other combinations of elastic material layers and necked materials may also be used.

As used herein, the term "polymeric precursor" refers to a material that may be treated to produce a polymeric layer by undergoing polymerization, curing, cross-linking, coalescing, drying or evaporation of a solvent. However, the term "polymeric precursor" does not exclude materials containing polymers. For example, often a latex formulation will contain polymers but the applied latex formulation does not form a solid material until dried.

As used herein, the term "elastomeric precursor" refers to a material that is not elastomeric as applied but may be treated to produce an elastic layer by undergoing polymerization, curing, cross-linking, coalescing, drying or evaporation of a solvent. However, the term "elastomeric precursor" does not exclude materials containing elastomers. For example, often a latex formulation will contain elastomers but the applied latex formulation does not form an elastic material until dried.

SUMMARY OF THE INVENTION

The aforesaid needs are fulfilled and problems experienced by those skilled in the art overcome by an elastic necked-bonded laminate made by the steps of: applying a polymeric precursor to a neckable material; necking said neckable material; and then treating the polymeric precursor thereby forming a tie layer which is directly attached to the necked material; and attaching an elastic sheet to the tie layer. The polymeric precursor may comprise a thermoset material which is treated by heating or a latex which is treated by drying. In a further aspect, the polymeric precursor may be applied to the neckable material in an amount sufficient to create a tie layer of from about 1 to about 100 g/m^2. Further, the polymeric precursor can be applied to the neckable material either prior to or during necking. Preferably the polymeric precursor comprises an elastomeric precursor which forms an elastic polymer layer when treated. In addition, the elastic sheet can be brought into contact with the polymeric precursor prior to treating the same to form the tie layer. For example, a molten elastomer may be extruded directly over the precursor thereby forming an elastic sheet and the tie layer. Alternatively, an elastic sheet can be brought into contact with the tie layer and joined thereto by the application of heat and/or pressure.

In a further aspect of the invention, an elastic necked-bonded laminate can be made by the steps of: applying a polymeric precursor to a necked material; then treating the polymeric precursor thereby forming a tie layer which is directly attached to the necked material; and bonding an elastic sheet to the tie layer. The polymeric precursor may comprise a thermoset material which is treated by heating or a latex which is treated by drying. Preferably, the polymeric precursor comprises an elastomeric precursor which forms an elastomeric polymer when treated. In addition, the precursor may be applied to the neckable material in an amount sufficient to create an elastic tie layer of from about 1 to about 100 g/m^2. In a further aspect, the elastic sheet can be brought into contact with the precursor prior to treating the same to form the tie layer. For example, a molten elastomer may be extruded directly over a precursor thereby forming an elastic sheet and tie layer. Alternatively, an elastic sheet can be brought into contact with the tie layer and joined thereto by the application of heat and/or pressure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic representation of an exemplary process for forming an elastic necked-bonded composite material having a polymeric tie layer.

FIG. 2 is a plan view of a neckable material under a tensioning force.

FIG. 3 is a plan view of a neckable material before tensioning and necking.

FIG. 3A is a plan view of a necked material.

FIG. 3B is a plan view of a composite elastic necked-bonded material while partially stretched.

FIG. 4 is a schematic representation of an exemplary process for forming an elastic necked-bonded composite material having a polymeric tie layer.

FIG. 5 is a schematic representation of an exemplary process for forming an elastic necked-bonded composite material having a polymeric tie layer.

FIG. 6 is a schematic representation of an exemplary process for forming an elastic necked-bonded composite material having a polymeric tie layer.

FIG. 7 is a top view of a necked material having a discontinuous patterned tie layer.

DETAILED DESCRIPTION OF THE INVENTION

In one aspect of the present invention, referring to FIG. 1, a neckable material 12 is unwound from a supply roll 14 and travels in the direction indicated by the arrows associated therewith as the supply roll 14 rotates in the direction of the arrows associated therewith. Those skilled in the art will appreciate that the neckable material 12 may be formed by known nonwoven extrusion processes such as, for example, meltblowing processes or spunbonding processes, without first being stored on a supply roll. A polymeric precursor 26 may then be applied to the neckable material 12 prior to necking. Thereafter, the neckable material 12 is necked to the desired width and the polymeric precursor 26 treated to form a polymeric tie layer 27. An elastic material 32 may then be joined to the tie layer 27 and the necked material 13 to from an elastic necked-bonded laminate 44.

The polymeric precursor may be applied in an amount sufficient to provide a tie layer 27 with a coverage of from about 1 to about 100 g/m^2, desirably from about 2 to about 50 g/m^2 and even more desirably about 2 to about 20 g/m^2. Preferred polymeric materials and their corresponding precursors are discussed herein below in greater

detail. The polymeric precursor 26 may be applied to the neckable material 12 by any of the numerous techniques known in the art for printing, coating or spraying materials on a sheet or fabric-like surface. The polymeric precursor 26 may be applied by various methods including, but not limited to, wire-wound coating bars, calendering, extrusion, spraying, direct gravure printing, knife-over-roll coating, floating-knife coating, reverse roll coating, rotary screen coating, transfer coating and flexographic printing. Further, it will be appreciated that the polymeric precursor may be applied in a single or successive applications. The polymeric precursor can be applied either directly or indirectly. For example, the precursor could be applied by coating the elastic sheet in a desired pattern and then pressing the elastic sheet and necked material together.

The desired method of applying particular polymeric precursors will vary in accord with factors well known to those skilled in the art, such as, the flow characteristics of the precursor, the desired thickness and gauge tolerance of the coating, line-speed and the surface characteristics of the material being coated. Flexographic or direct gravure printing are preferred since it is desirable to have a discontinuous layer, e.g. a patterned layer, of precursor applied to the neckable material. In gravure, flexographic and screen printing equipment, the printed composition is transferred to a printing transfer surface which contains the printed patterns and then from the transfer surface the printing composition is transferred directly to the substrate.

In reference to the embodiment of FIG. 1, the neckable material 12 passes through a nip 18 of an S-roll type drive roll arrangement 16 formed by stacked drive rolls 20 and 22. A polymeric precursor 26 is applied to the neckable material 12 by a coating assembly 24, such as a gravure-print coater. The individual rolls of the coating assembly 24 rotate and guide the precursor 26 onto the neckable material 12. The polymeric precursor 26 is removed from the coater 24 by lightly pressing the precursor 26 against the neckable material 12 in the final nip of coating assembly 24 created with roll 22 of drive roll assembly 16.

Penetration of the polymeric precursor typically occurs without the need for additional means for pressing or driving the precursor into the neckable material. For example, although polyolefin nonwoven webs are often hydrophobic, many latex formulations include surfactants which make the latex compatible with the nonwoven material and are thus readily wicked or absorbed into the web. However, in the event further penetration is desired an additional pressure roll arrangement may be provided to obtain the desired penetration. Further, either the composition of the precursor may be

varied or the neckable material treated such as by corona treatment to achieve the desired compatibility between the materials.

With porous neckable materials, such as a nonwoven web, the depth to which the precursor 26 penetrates the neckable material 12 affects the elastic properties of the necked-bonded laminate produced. Generally, the elastic properties of the resulting laminate decrease as the degree of penetration of precursor 26 increases. Further, since the treated polymeric precursor 26 will act as a tie layer it is desirous to have a substantial portion of the polymeric precursor located at or near the surface of the neckable material. Moreover, strikethrough of the precursor and the resulting polymer can detract from the soft hand of the neckable material. Thus, the nip pressure should be closely controlled while the precursor has not been treated to form the polymeric tie layer. In most cases, a gap will be maintained between the rolls to insure that the precursor does not significantly penetrate into the neckable material. However, penetration of the precursor near the surface is desirable where the tie layer does not sufficiently bond to the necked material since, when treated, the resulting tie layer will form a material which is embedded in the neckable material. For example, with nonwoven materials the tie layer will often surround fibers within the web thereby providing mechanical attachment to the web. Thus, it is preferred in such instances that the precursor penetrates at least one fiber thickness and preferably penetrates from 2 to about 5 fiber thicknesses.

Penetration of the precursor into the neckable material may be limited or controlled by various means. For example, the neckable material may be treated immediately after being applied to the neckable material thereby limiting the extent to which a viscous precursor can be drawn into the neckable material. In addition, the neckable material may include a barrier to further penetration of the precursor. For example, the neckable material may comprise a multilayer laminate, e.g. an SMS, having an internal meltblown layer therein which prevents strike-through and unwanted penetration of the precursor. Nonwoven meltblown fabrics having fiber diameters less than 10 microns typically have very small pore structures which will often prevent penetration of the precursor. Alternatively, larger fiber diameter nonwovens with larger pore sizes may be treated with or include a repellent, such as a fluorocarbon, which prevents penetration of the precursor into the fabric; see U.S. Patent 5,441,056 issued to Weber et al., the entire contents of which are incorporated herein by reference. In this regard, a neckable material may be produced using multiple spunbond banks wherein one or more banks produce layers of spunbond fibers which are treated with or otherwise

incorporate the repellent and at least the last bank forms a layer of untreated fibers over the previously laid repellent-treated fibers. The multiple layers of spunbond fibers may then be bonded to form a coherent web capable of being necked. Thus, when the precursor is applied to the neckable material it will penetrate only the repellent-free fibers located at the upper surface of the neckable material.

From the drive-roll assembly 16, the neckable material 12 undergoes neck-stretching, being pulled by the pressure nip formed by a bonder-roll arrangement 36. Because the peripheral linear speed of the rolls of the drive-roll assembly 16 is controlled to be less than the peripheral linear speed of the bonder-roll assembly 36, the neckable material 12 is tensioned between the drive-roll assembly 16 and the bonder-roll assembly 36. By adjusting the distance between and the difference in the speeds of the roll assemblies 16 and 36, the neckable material 12 is tensioned so that it necks a desired amount, forming necked material 13.

The neckable material 12 necks before reaching the treating device 30, however, necked material 13 may neck further upon heating. The distance between drive roll assemblies 16 and 36 responsible for necking the neckable material 12 should be sufficient to achieve the desired neckdown. In reference to FIG. 2, a neckable material 12 is necked-stretched between a first and second roll assembly 16 and 36. However, the percent neckdown increases as the neckable material travels away from the first roll assembly 16 towards the second roll assembly 36. The neckable material 12 necks approaching equilibrium, a point at which without additional tensioning force or heating no further necking will occur. Desirably drive roll assemblies are separated a sufficient distance to substantially approach equilibrium. Further, it is also desirable that the precursor (not shown) is treated, at a point along the distance between the first and second roll assemblies 16 and 36, such that the tie layer is not formed until after the neckable material is necked a desired amount.

The relation between the original dimensions of the neckable material 12 to its dimensions after tensioning and necking determines the approximate limits of stretch of the elastic necked-bonded material 44. Because the necked material 13 is able to stretch and return to its pre-necked dimensions in the cross-machine direction, the elastic necked-bonded material 44 will be stretchable in generally the same direction that the neckable material 12 was necked.

For example, with reference to Figs. 3, 3A, and 3B, if it is desired to prepare an elastic necked-bonded composite material stretchable to a 150% elongation, a width of neckable material shown schematically and not necessarily to scale in Fig. 3 having a

width "A" such as, for example, 250 cm, is tensioned by force F so that it necks down to a width "B" of about 100 cm. The elastic precursor (not shown) is then treated to form an elastic tie layer (not shown). Further, an elastic sheet having a width of approximately 100 cm is joined to the necked material and tie layer. The resulting composite elastic necked-bonded material shown schematically and not necessarily to scale in Fig. 3B has a width "B" of about 100 cm and is stretchable to the original 250 cm width "A" of the neckable material for an elongation of about 150% (or as discussed herein above, the material is stretchable to 250% of its relaxed unbiased width). The elastic limit of a continuous elastic tie layer and/or elastic sheet need only be as great as the maximum desired elongation of the composite elastic necked-bonded material. However, it will typically be desirable to employ elastic materials which will readily allow the necked material to be elongated to at least its pre-necked dimensions.

The necked material 13 is maintained in a tensioned, necked condition while the polymeric precursor 26 is treated, thereby forming a tie layer 27 in intimate contact with the necked material 13. In this regard it is important to note that due to the ability of the precursor 26 to penetrate into the neckable material 12 when applied, treatment of the precursor 26 forms a polymeric material which attaches to the to the necked material by bonding directly to the material and/or mechanically attaching thereto by solidifying about fibers at or near the surface of the necked material 13.

Treatment of the precursor 26 will vary with regard to the particular precursor and the mechanism responsible for generating the polymeric tie layer 27. For example, reactions may be induced to form thermoset materials by various means such as infrared radiation, ultrasound, ultraviolet radiation, x-ray, electron beam, etc. Polymeric precursors employing these and/or other initiators used to form a compatible polymeric material are believed suitable for use with the present invention. Nevertheless, the most common commercially available polymeric precursors typically include thermoset and latex formulations that are activated by heating or dried by heating or microwaves. Thus, although the particular embodiments discussed herein are directed toward use of heat set and/or latex formulations, the invention is not limited to use of such materials or processes employing the same.

In reference to the particular embodiment depicted in FIG. 1, a precursor 26, such as a latex or thermoset formulation, may be treated by heating the applied precursor 26 in treating apparatus 30, such as an oven. In instances in which the treatment of the precursor 26 includes heating, it will be noted that this may be performed simultaneously with heating the necked material to create a "reversibly necked material" as described in

U.S. Patent No. 4,965,122 to Morman, the entire contents of which are incorporated herein by reference. In addition, a heating device may have multiple temperature control zones (not shown) so that the necking process is substantially completed to the desired amount before significant treatment of the precursor.

Still in reference to FIG. 1, an elastic sheet 32 may be unwound from a supply roll 34 and fed into the nip 38 of bonder-roll assembly 36 along with the necked material 13 and tie layer 27. The elastic sheet 32 is fed into the bonder-roll assembly in conjunction with the necked material 13 such that the elastic sheet 32 is in intimate contact with the tie layer 27. The peripheral linear speed of the elastic sheet supply roll 34 may be varied as desired. For example, the linear speed of the supply roll 34 can be substantially the same as that of bonder-roll assembly 36 so no stretching of the elastic sheet 32 is experienced.

The bonder-roll assembly 36 may be a patterned calender roll 40 arranged with a smooth anvil roll 42. Alternatively, a smooth calender roll may be used. It is further desirable to heat the layered materials, while in direct physical contact, to a temperature sufficient to attach the tie layer 27 and the elastic sheet 32. The particular temperature and pressure required will vary with the specific elastic materials selected. One or both of the calender roll 40 and the anvil roll 42 can be heated and the pressure between these two rolls adjusted by well known means to provide the desired temperature and bonding pressure. Various bond patterns may be used including, but not limited to, sinusoidal dot patterns and those patterns mentioned above in connection with the point bonding. The bond surface area on the composite elastic necked bonded material 44 may approach about 100 percent and still provide an elastic laminate material with good elastic properties. Other methods may be used to join the materials such as, for example, ultrasonic welding, laser beams, high energy electron beams and/or by other means known in the art.

The tie layer 27 directly attaches to the necked material 13 and, thus, provides improved integrity to the resulting necked-bonded laminate. The integrity may be further improved due to the ability to achieve better adhesion between the tie layer 27 and the elastic layer 32 as compared with that between the neckable material 13 and elastic sheet 32. However, when the tie layer is itself elastic and does not significantly penetrate the neckable material, the stretch and recovery characteristics of the resulting necked-bonded laminates are not materially degraded. Moreover, due to the nature of necked-bonded materials use of an elastic tie layer will reduce rupture of bond areas and/or the creation of high stress points within the laminate.

Although use of an elastomeric precursor and elastic tie layer are preferred, it is also possible to employ inelastic polymers as the tie layer. Such polymeric precursors can be formed upon the necked or neckable material in a manner that does not significantly detract from the elastic properties of the resulting laminate. For example and in reference to FIG. 7, the tie layer 27 can be formed over the necked material 13 in continuous sections or closely spaced columnar points that extend in a direction substantially perpendicular to the necked direction. Thus, where the necked-stretched material is stretched in the machine direction the tie layer would extend substantially parallel to the machine direction. For example, in reference to Fig. 7, the tie layer 27 can comprise spaced columns of polymer extending in the machine direction of necked material 13. Such a pattern still allows the fabric to stretch and recover in the necked direction. Desirably such patterns would occupy less than about 70% of the surface area of the single side of the treated fabric.

Conventional drive means and other conventional devices which may be utilized in conjunction with the apparatus of Fig. 1 are well known and, for purposes of clarity, have not been illustrated in the schematic view of Fig. 1. In addition, it will be appreciated by those skilled in the art that the particular process could be varied in numerous respects without departing from the spirit and scope of the invention. For example, the neckable material may be pre-necked and treated to remain in its necked condition (e.g. reversibly necked) prior to being wound on the supply roll 14. As a further example, after treatment of the precursor and formation of the tie layer, the elastic sheet could be formed directly over the coated side of the neckable material such as by extruding a film of molten elastomer thereover; see U.S. Patent No. 5,514,470 issued to Haffner et al., the entire contents of which are incorporated herein by reference. It will be further appreciated that the method of the present invention may be used in connection with others known in the art to fabricate a material which is stretchable in both the cross-machine and machine direction, see U.S. Patent No. 5,116,662 issued to Morman, the entire contents of which are incorporated herein by reference. For example, the peripheral linear speed of roll 34 could be adjusted to be lower than that of roll assembly 36 thereby stretching the elastic layer 32. This will give the resulting laminate stretch in both the MD and CD directions.

In addition, those skilled in the art will appreciate that other methods of tensioning the neckable material 12 may be used such as, for example, tenter frames or other directional stretcher arrangements that expand the neckable material 12 in other directions such as, for example, the cross-machine direction so that, after bonding to the

elastomeric material to the necked material, the resulting composite elastic necked-bonded material 44 will be elastic in a direction generally perpendicular to the direction of necking, e.g. in the machine direction. The nonelastic material may also be gathered prior to necking. In such instances, the tensioning force may not narrow the fabric with respect to the gathered dimensions, however the fabric will be narrower than the fabric's original pre-gathered dimensions. "Necking" is intended to cover such tensioning and narrowing relative to the pre-gathered dimensions.

The neckable material 12 may be a knit, loosely woven or nonwoven material such as, for example, spunbonded web, meltblown web, coformed webs or bonded carded webs. If the neckable material is a nonwoven web, it may include microfibers. The neckable material may be any porous material that can be necked. The neckable material 12 may be made of fiber forming polymers such as, for example, polyesters, polyamides and polyolefins. Exemplary polyolefins include one or more of polypropylene, polyethylene, ethylene copolymers, propylene copolymers, and butene copolymers. Useful polypropylenes include, for example, polypropylene available from the Exxon Chemical Company under the trade designation Exxon 3445, and polypropylene available from the Shell Chemical Company under the trade designation DX 5A09. Polyamides which may be used in the practice of this invention may be any polyamide known to those skilled in the art including copolymers and mixtures thereof. Particularly commercially useful polyamides are nylon-6, nylon 6,6, nylon-11 and nylon-12. These polyamides are available from a number of sources such as Emser Industries of Sumter, South Carolina (Grilon® & Grilamid® nylons) and Atochem Inc. Polymers Division, of Glen Rock, New Jersey (Rilsan® nylons), among others.

In one embodiment of the present invention, the neckable material 12 may itself comprise a multilayer laminate having, for example, at least one layer of spunbonded web joined to at least one layer of meltblown web, bonded carded web or other suitable material. For example, neckable material 12 may be a multilayer material having a first layer of spunbonded polypropylene having a basis weight from about 3.5 to about 270 g/m^2, a layer of meltblown polypropylene having a basis weight from about 3.5 to about 135 g/m^2, and a second layer of spunbonded polypropylene having a basis weight of about 3.5 to about 270 g/m^2. Alternatively, the neckable material 12 may be single layer of material such as, for example, a spunbonded web having a basis weight of from about 3.5 to about 340 g/m^2 or a meltblown web having a basis weight of from about 3.5 to about 270 g/m^2.

The neckable material 12 may also be a composite material made of a mixture of two or more different fibers or a mixture of fibers and particulates. Such mixtures may be formed by adding fibers and/or particulates to the gas stream in which meltblown or spunbond fibers are carried so that an intimate entangled commingling of meltblown or spunbond fibers and other materials occurs prior to collection of the fibers upon a collecting device to form a coherent web of randomly dispersed fibers and other materials. Examples of such materials include, but are not limited to, wood pulp, staple fibers and particulates such as, for example, hydrocolloid (hydrogel) particulates commonly referred to as superabsorbent materials.

If the neckable material 12 is a nonwoven web of fibers, the fibers should form a coherent web structure which is able to withstand tensioning and the resulting necking. The coherent web structure may be produced by bonding or entanglement between individual fibers which is inherent in the meltblown process. For materials which do not inherently form a coherent web, processes such as, for example, hydraulic entangling, point bonding, through-air bonding or needlepunching may be used to impart the desired degree of integrity. Alternatively or additionally a bonding agent may be used to achieve the desired bonding.

The precursor may comprise any material which may be applied to the neckable material and subsequently treated to induce drying, polymerization, cross-linking or the like, to form a polymeric sheet or layer. Preferably the precursor, once treated, forms an elastic polymer. In this regard a great variety of polymers and/or elastomers are known in the art such as, for example, polyurethanes, silicone rubbers, poly(isobutylene-isoprene), poly(styrene-butadiene), poly(acrylonitrile-butadiene), polychloroprene, polyisoprene, polysulfides, poly(ethylene-propylene-diene), chlorosulfonated polyethylene, polysiloxanes, poly(fluorinated hydrocarbon), poly(acrylate-butadiene), poly(styrene-ethylene/butylene-styrene). In one aspect of the invention, the elastomeric precursor may comprise a thermoset material which, in accord with the historical meaning of the term, cross-links upon heating. However, elastomeric precursors may also include materials which fall under the broader understanding of thermoset materials such as those in which further polymerization, cross-linking or curing is induced by means other than heat, such as by UV irradiation, infrared irradiation, ultrasound as well as other methods known in the art.

Latex formulations, including those for thermoplastic elastomers, may also be used in the present invention. With latex formulations, a tie layer is not formed until such time as the emulsion is treated, which typically consists of driving off or evaporating

water. In addition, elastomeric precursors capable of forming open and closed cell elastic foams, an example being a latex foam rubber, can also be used in connection with the present invention. As an example, some polyurethanes give off CO_2 gas when they react which acts to form a closed cell foam elastomer.

Typically the precursor will be compounded to reduce costs and improve processing and therefore the specific formulations will vary with regard to the manner of application and mechanism for drying, polymerization, curing and/or cross-linking of the precursor. Formulations for calendering poly(styrene-butadiene) and polychloroprenes are discussed in the *Encyclopedia of Polymer Science and Engineering,* vol. 6, pgs. 636-638 (1986). In addition, numerous suitable elastomeric precursors are available commercially, examples including: DPX-546.00 which is produced by DEXCO (a joint venture between Dow Chemical and Exxon) which is a thermoplastic latex formulation comprised of styrene-isoprene-styrene block copolymers; acrylic latex HYSTRETCH V-29 available from the B.F. Goodrich Co.; silicone rubber LSR 590 which is a two part cross-linkable material available from Dow-Corning; and Q-THANE QW24 which is a polyurethane emulsion made by K.J. Quinn & Co. of Seabrook, New Hampshire.

Further, the elastomeric precursor may comprise a latex having an elastomer which is made from block copolymers having the general formula A-B-A' where A and A' are each a thermoplastic polymer endblock which contains a styrenic moiety such as a poly (vinyl arene) and where B is an elastomeric polymer midblock such as a conjugated diene or a lower alkene polymer. The elastomeric precursor may be formed from, for example, a latex formulation including (polystyrene/poly(ethylene-butylene)/polystyrene) block copolymers available from the Shell Chemical Company under the trademark KRATON.

The tie layer 27 may itself be tacky or, alternatively, a compatible tackifying resin may be added to the precursor formulation to provide a tie layer 27 which provides improved bonding between the elastomeric sheet 32 and the necked material 12. In regard to the tackifying resins and tackified elastomeric compositions, note the resins and compositions as described in U.S. Patent No. 4,789,699 issued to Keiffer et al., the disclosure of which is hereby entirely incorporated by reference. Any tackifier resin can be used which is compatible with the precursor, the neckable material and can withstand the processing conditions (e.g. temperature). If blending materials such as, for example, polyolefins or extending oils are used, the tackifier resin should also be compatible with those blending materials. REGALREZ and ARKON P series tackifiers are examples of hydrogenated hydrocarbon resins. ZONATAK 501 is an example of a terpene

hydrocarbon. REGALREZ hydrocarbon resins are available from Hercules Incorporated. ARKON P series resins are available from Arakawa Chemical (U.S.A.) Incorporated. Of course, the present invention is not limited to use of the aforesaid tackifying resins, and other tackifying resins, which are compatible with the other components and can withstand the processing conditions, can also be used.

The elastic sheet brought into contact with the precursor or tie layer may be made from a wide variety of elastomeric materials, desirably from materials which allow the elastic material to be manufactured into sheet form. Suitable commercially available materials include, but are not limited to, a poly(styrene/ethylene-butylene/styrene) block copolymer available from the Shell Chemical Co. under the trademark KRATON G; polyurethane elastomeric materials such as those available under the trademark ESTANE from B.F. Goodrich & Co.; polyamide elastomeric materials such as those available the trademark PEBAX from the Rislan Co.; and polyester elastomeric materials such as those available under the name HYTREL from E.I. DuPont De Nemours & Co. In addition, the elastic layer may be a multilayer material in that it may include two or more individual coherent webs or films. Additionally, the elastic sheet, or one of the layers in a multilayer elastic material, may contain a mixture of elastic and nonelastic fibers or particulates.

Elastic sheets preferably have basis weights less than about 30 g/m^2, for example, from about 8.5 to about 25 g/m^2. Such low basis weight sheets are useful for economic reasons, particularly for use in disposable products. However, depending on the desired application of the elastic composite, elastic sheets having higher basis weights such as, for example, from about 30 to about 340 g/m^2 may also be used.

As indicated above with regard to the tie layer, tackifier may likewise be added to the elastic sheet to improve its ability to adhere to the neckable material the tie layer. However, when significant tackifier is used within the elastic sheet it will often be desirable to include an additional sheet of material, such as a second neckable material (or necked material depending on the point of engagement) prior to winding the elastic necked-bonded laminate on a winder-roll in order to prevent the tacky elastic sheet from adhering to the back of adjacent materials on the roll. Alternatively, dusting of the elastic sheet may also be used to prevent unwanted attachment from occurring when the elastic necked-bonded composite material is wound in roll form.

In a further aspect of the invention, an elastic necked-bonded composite is formed upon treating the elastomeric precursor 26 while in contact with both the necked material 13 and the elastic sheet 32. In reference to FIG. 4, there is schematically

illustrated an exemplary process for forming a composite elastic necked-bonded material 62 by application of an elastomeric precursor 26 to a necked material 13. A necked material 13, an example being a reversibly necked material, is unwound from a supply roll 14 and travels in the direction indicated by the arrows associated therewith as the supply roll 14 rotates in the direction of the arrows associated therewith. An elastic sheet 32 is simultaneously unwound from a second supply roll 34. Necked material 13 and elastic sheet 32 pass through nip 54 of the roll assembly 52. However, prior to entering the nip 54 of the roll assembly 52 an elastomeric precursor 26 is applied to the necked material 13 by coating assembly 24, such as a bank of spray heads. The coating assembly may be positioned in relation to nip 54 such that the elastomeric precursor 26 is applied to both the necked material 13 and the elastic sheet 32. The necked material 13, elastic sheet 32 and elastomeric precursor 26 together, with the aid of guide roll 56, pass through the S-roll assembly 52 formed by the rolls 58 and 59.

The S-roll assembly 52 may comprise a series of heated rolls 58 and 59 which treat the elastomeric precursor 26, e.g. dry or polymerize the precursor 26. Treating the precursor 26 forms a polymeric tie layer which is directly bonded to the necked material 13 as well as the elastic sheet 32, collectively the multiple layers comprise an elastic necked-bonded laminate 62. One skilled in the art will appreciate that some formulations may require longer treatment times than provided by heated calender rolls 58 and 59 and in such instances other conventional in-line heating techniques may be employed such as by additional heated rolls, infrared heaters, microwave heaters, heating lamps, ovens and other heating devices known in the art.

As a further example, a bonder-roll arrangement (not shown) may be included in the processing after treatment of the elastomeric precursor 26. The bonder-roll arrangement may comprise a smooth calender roll and a smooth anvil roll or may include a patterned calender roll, such as, for example, a pin embossing roll arranged with a smooth anvil roll as discussed herein above. Both the calender roll and the smooth anvil roll can be heated and the pressure between these two rolls adjusted by well known means to provide a temperature sufficient to heat the tie layer and/or elastic sheet to create attachment. The necessary heat and/or pressure applied to attach the respective layers will vary with the selected materials. Typically, sufficient heat and pressure will be directly applied to heat one of the materials sufficiently above its T_g to cause it to soften.

Conventional drive means and other conventional devices which may be utilized in conjunction with the apparatus of Fig. 4 are well known and, for purposes of clarity, have not been illustrated in the schematic view of Fig. 4. In addition, it will be

appreciated by those skilled in the art that the particular process could be varied in numerous respects without departing from the spirit and scope of the invention. For example, the neckable material and elastic sheet can be formed by known extrusion processes, such as those discussed herein above, without first being stored on supply rolls 14 and 34. Further, it will be appreciated that since the multiple layers are being brought into physical contact prior to treating the elastomeric precursor, the precursor could be applied solely to either the necked material 13 or the elastic layer 32.

In a further aspect of the invention, referring now to Fig. 5 of the drawings, there is schematically illustrated an exemplary process for forming an elastic necked-bonded material comprising multiple nonelastic neckable materials. A first and second neckable materials 12A and 12B are unwound from supply rolls 14A and 14B. The first and second neckable materials 12A and 12B then travel in the direction indicated by the arrow associated therewith as the supply roll 14A and 14B rotates in the direction of the arrows associated therewith. The neckable materials may be formed by nonwoven extrusion processes, such as, for example, spunbonding or meltblowing processes, and fed directly into the present processing line without first being stored on a supply roll. It is noted that for the purposes of the present invention the first and second neckable materials need not be identical or even similar materials. An elastic sheet 32 is simultaneously unwound from a supply roll 34 and travels in the direction indicated by the arrow associated therewith. The elastic sheet 32 is juxtaposed between the first and second neckable materials 12A and 12B as the materials are fed into nip 74 of roll assembly 72.

Before the first and second neckable materials 12A and 12B come into contact with the elastic sheet 32 or enter the nip 74 of the roll assembly 72, the neckable materials 12A and 12B each pass under respective coating assemblies 24A and 24B. A stream of precursor 26A and 26B, directed from bank of spray heads traversing the width of the neckable materials 12A and 12B, coat the side of the neckable materials 12A and 12B that will face the elastic sheet 32. The elastomeric precursor 26A and 26B may be applied just prior to nip 74, the point at which the juxtaposed neckable materials 12A and 12B and elastic sheet 32 are brought into contact. This allows both neckable materials 12A and 12B as well as both sides of the elastic sheet 32 to be coated with the elastomeric precursor 26. The precursor 26 may, however, alternatively be applied by other coating processes.

The juxtaposed neckable materials 12A and 12B and elastic sheet 32 are guided into and through the drive-roll assembly 80. Because the peripheral linear speed of the

rolls of the S-roll assembly 90 is controlled to be higher than the drive-roll assembly 80, the contiguous materials are tensioned between the roll assemblies 80 and 90. By adjusting the difference in the peripheral linear speed of the rolls, the multiple layers of material are tensioned and neck a desired amount, forming necked multi-layered material 88. Additional roll assemblies can be added to the process if additional necking or multi-stage necking is desired. The respective components neck before entering the treating device, however, the necked multi-layered material 88 may neck further upon heating. The necked materials 12A, 12B and elastic sheet 32 are maintained in such contiguous tensioned, necked condition while forming the tie layers.

The multi-layered necked material 88 is heated by traveling through heated S-roll assembly 90 thereby forming tie layers, which are in intimate contact with the elastic sheet and the respective necked materials. In the particular embodiment of FIG. 5, the multi-layered material 88 is heated while traveling about heated rolls 92 and 94 which form stacked S-roll assembly 90 so that both sides of the fabric are heated. It is important to note that due to the ability of the precursor 26 to penetrate into the surface of neckable materials12A and 12B when applied, treatment of the precursor 26 forms a tie layer which attaches to the to the necked material by bonding directly to the material and/or mechanically attaching thereto by physically forming around fibers at or near the surface of the neckable materials 12A and 12B. In addition, the heating provided by treating apparatus 30 may also sufficiently heat the elastic sheet 32 to reset the thermoplastic elastic sheet 32 to the necked dimensions. Additional heating and/or bonding may be provided, such as by heated rolls 40 and 42 as desired. The elastic necked bonded composite is then wound on wind-up roll 46.

Conventional drive means and other conventional devices which may be utilized in conjunction with the apparatus of Fig. 5 are well known and, for purposes of clarity, have not been illustrated in the schematic view of Fig. 5. In addition, as mentioned herein above, it will be appreciated by those skilled in the art that the particular process could be varied in numerous respects without departing from the spirit and scope of the invention. As an example, the precursor could be applied to the neckable layers 12A and 12B by coating both sides of the elastic sheet 32 with the precursor 26. As an additional example, it is noted that some elastomeric precursors will, given sufficient time, react at room temperature and thus with such formulations heating the contiguous necked layers could be omitted. While wound on supply roll 46 the layers are kept in direct contact by the pressure experienced on the roll allowing the precursor 26 to cure thereby forming an elastic necked-bonded laminate while on the roll 46.

In a further aspect of the invention, referring to FIG. 6, an elastic necked-bonded material may be formed by applying a molten elastomer over the elastic tie layer and necked material. A neckable material 12 is unwound from a supply roll 14 and travels in the direction indicated by the arrows associated therewith. The peripheral linear speed of the supply roll 14 is selected to be less than that of calender roll assembly 24, the neckable material is then tensioned a desired amount between the supply roll 14 and driver roll assembly 24. The neckable material may be heated by a heating device 102 while being necked. A precursor 26 is then printed on the necked material 13 by roll assembly 24. Just prior to entering nip 108, formed by rolls 112 and 114 of S-roll assembly 110, a molten elastomer 104 is extruded over the elastomeric precursor 26 and necked material 13. For example, molten polyurethane at about 400 °F may be extruded through one or more die tips 106 onto the precursor 26 forming an elastic sheet 32. The heat from the molten elastomer 104 acts to treat the precursor 26, e.g. dry a latex, and form tie layer 27. The second roll 114 of S-roll assembly 110 may be chilled in order to help rapidly cool the molten elastomer and thereby forming an elastic sheet 32 and the elastic necked-bonded laminate.

Conventional drive means and other conventional devices which may be utilized in connection with the apparatus of FIG. 6 are well known and, for the purpose of clarity, have not been illustrated in the schematic view of FIG. 6. In addition, as mentioned herein above, it will be appreciated by those skilled in the art that the particular process could be varied in numerous respects without departing from the spirit and scope of the invention. As an example, the elastomeric precursor could be applied prior to necking the neckable material 12 or during necking and prior to heating.

EXAMPLE 1

Spunbond material was pre-necked from 132 inches wide material to 52 inches wide, aging on the roll and handling of the roll allowed the material to equivalently relax to 72 inches wide. An acrylic latex, HYCAR 26804 purchased from B.F. Goodrich, was diluted to about 35% by weight solids and the pH adjusted to about 8.5 with ammonia. The acrylic latex was sprayed over the necked spunbond material using a PAASHE Airbrush set VL-SET with a No. 5 needle and No. 5 head. The acrylic latex was sprayed through a pegboard having ¼ inch diameter holes in each 1 inch square cell. The spunbond material had a basis weight of 45.08 g/m^2 prior to application of the acrylic latex and a basis weight of 47.55 g/m^2 after application of the latex and drying in an oven

for over 2 minutes at 108 °C. The spunbond material and applied acrylic latex were juxtaposed with an elastic film of an elastic thermoplastic polyurethane, ESTANE 58661, purchased from B. F. Goodrich, and placed in a t-shirt press for 20 seconds at 130 °C. The resulting elastic necked bonded composite material had good adhesion between the respective layers and excellent elastic properties.

While the invention has been described in detail with respect to specific embodiments thereof, it will be apparent to those skilled in the art that various alterations, modifications and other changes may be made to the invention without departing from the spirit and scope of the present invention. It is therefore intended that the claims cover all such modifications, alterations and other changes encompassed by the appended claims.

What is claimed is:

1. A method of forming a stretchable composite comprising:

applying a polymeric precursor to a first neckable material;

neck-stretching said neckable material to form a necked material; then

treating said polymeric precursor to form a polymeric tie layer wherein said polymeric tie layer bonds to said necked material; and

bonding an elastic sheet to said polymeric tie layer wherein said neckable material recovers when stretched in the necked direction.

2. A method according to claim 1 wherein said polymeric precursor is applied to said neckable material in a discontinuous pattern before neck-stretching said neckable material.

3. A method according to claim 2 wherein said polymeric precursor comprises a latex.

4. A method according to claim 3 wherein treating said polymeric precursor comprises drying said latex.

5. A method according to claim 2 wherein said polymeric layer comprises a thermoset polymer.

6. A method according to claim 5 wherein treating said polymeric precursor comprises heating.

7. A method according to claim 1 wherein said precursor is an elastomeric precursor and wherein said elastomeric precursor is applied to said neckable material before neck-stretching said neckable material.

8. A method according to claim 7 wherein said elastomeric precursor comprises a latex.

9. A method according to claim 8 wherein treating said elastomeric precursor comprises drying said latex.

10. A method according to claim 7 wherein said elastomeric layer comprises a thermoset polymer.

11. A method according to claim 10 wherein treating said elastomeric precursor comprises heating.

12. A method according to claim 11 further comprising the step of cooling said necked material in the necked condition wherein a reversibly necked material is formed from said neckable material.

13. A method according to claim 7 wherein said elastic layer is formed by applying a molten elastomer over said elastomeric precursor.

14. A method according to claim 7 wherein applying said elastomeric precursor comprises applying about 1 g/m^2 to about 50 g/m^2 of said elastomeric precursor to said neckable material.

15. A method according to claim 7 wherein applying said elastomeric precursor comprises applying less than about 20 g/m^2 of said elastomeric precursor to said neckable material.

16. A method according to claim 7 wherein said elastomeric precursor is treated and then the elastic sheet is brought into contact with said elastomeric tie layer and bonded thereto.

17. A method according to claim 7 wherein said elastic sheet is brought into contact with said elastomeric precursor before treating to form the elastomeric tie layer.

18. A method according to claim 1 wherein said polymeric precursor is applied to said neckable material after neck-stretching said neckable material.

19. A method according to claim 13 wherein said polymeric precursor comprises a latex.

20. A method according to claim 14 wherein treating said polymeric precursor comprises drying said latex.

21. A method according to claim 13 wherein said polymeric layer comprises a thermoset polymer.

22. A method according to claim 16 wherein treating said polymeric precursor comprises heating.

23. A method according to claim 1 wherein said polymeric precursor comprises an elastomeric precursor and wherein said elastomeric precursor is applied to said neckable material after neck-stretching said neckable material.

24. A method according to claim 23 wherein said elastomeric precursor comprises a latex.

25. A method according to claim 24 wherein treating said elastomeric precursor comprises drying said latex.

26. A method according to claim 23 wherein said elastomeric precursor comprises a thermoset polymer.

27. A method according to claim 26 wherein treating said elastomeric precursor comprises heating.

28. A method according to claim 27 further comprising the step of cooling said necked material in the necked condition wherein a reversibly necked material is formed from said neckable material.

29. A method according to claim 23 wherein said elastic layer is formed by applying a molten elastomer over said elastomeric precursor.

30. A method according to claim 23 wherein applying said elastomeric precursor comprises applying from about 1g/m^2 to about 50g/m^2 of said elastomeric precursor to said neckable material.

31. A method according to claim 23 wherein applying said elastomeric precursor comprises applying less than about 20 g/m^2 of said elastomeric precursor to said neckable material.

32. A method according to claim 30 wherein said elastomeric precursor is treated and then the elastic sheet is brought into contact with said elastomeric tie layer and bonded thereto.

33. A method according to claim 30 wherein said elastic sheet is brought into contact with said elastomeric precursor before treating to form the elastomeric tie layer.

34. An elastic necked-bonded composite formed by the process of claim 1.

35. An elastic necked-bonded material comprising:

a porous necked material;

an elastic tie layer in intimate contact with said necked material wherein said elastic layer is mechanically attached to said necked material by surrounding portions of said porous material; and

an elastic sheet bonded to said elastic tie layer.

36. The necked-bonded composite of claim 35 wherein said porous material is a nonwoven material.

37. The neck-bonded composite of claim 35 wherein said elastic layer comprises an elastic thermoset polymer.

38. The necked-bonded composite of claim 35 wherein said elastic tie layer comprises less than about 20g/m^2.

39. The necked-bonded composite of claim 35 wherein said elastic tie layer comprises 1 g/m^2 to about 50 g/m^2.

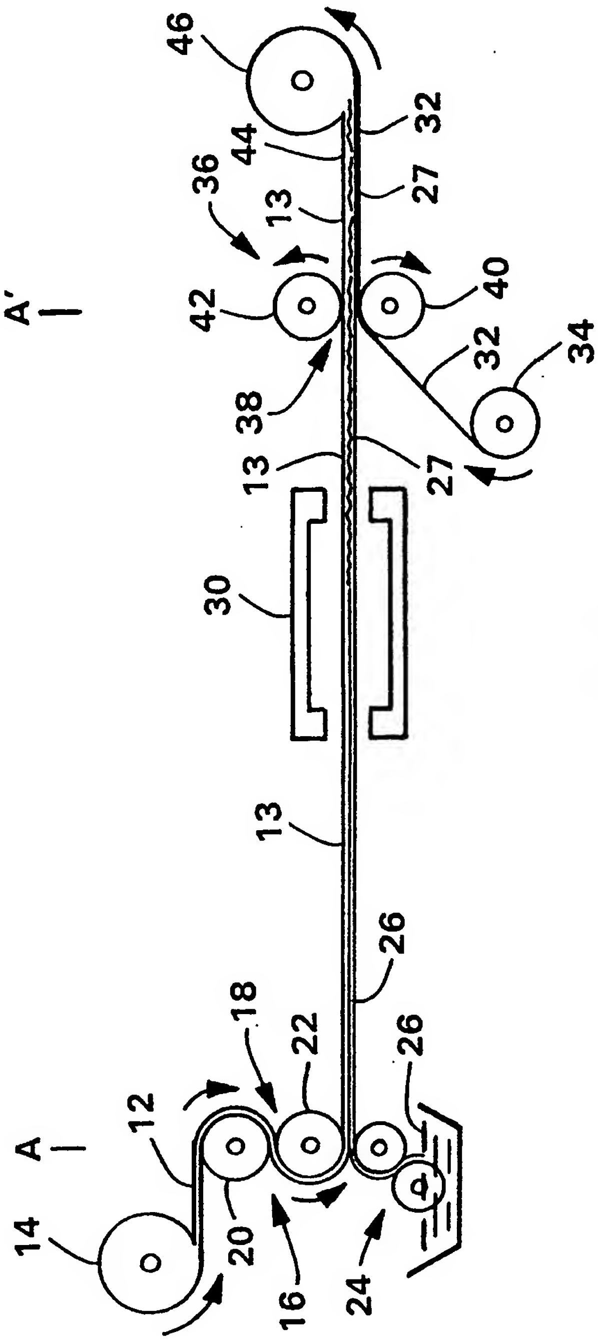
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FIG. 1

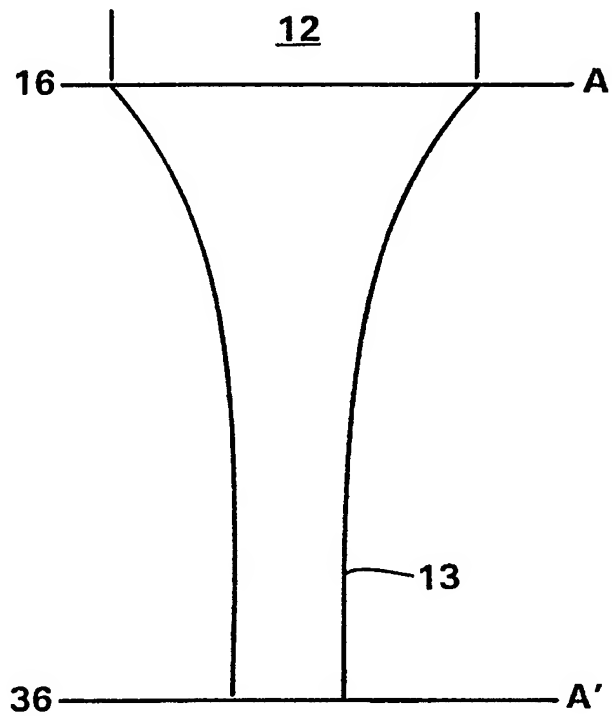


FIG. 2

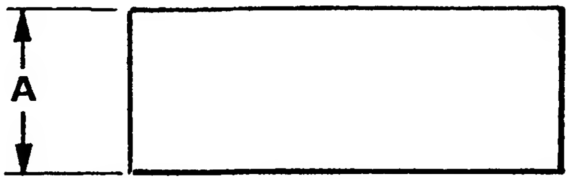


FIG. 3

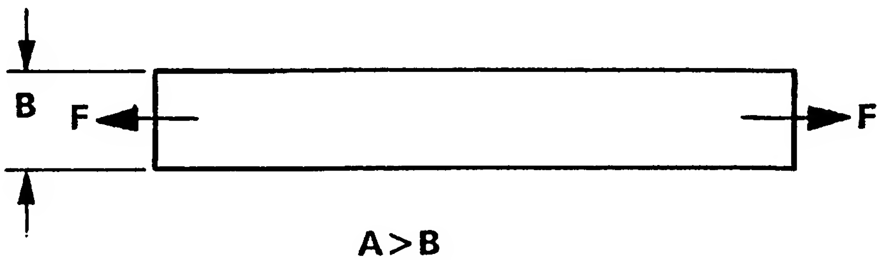


FIG. 3A

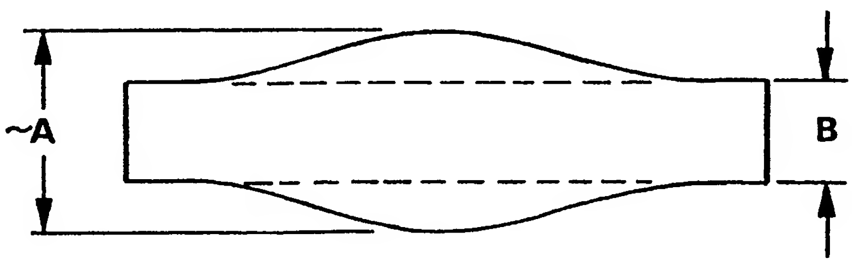


FIG. 3B

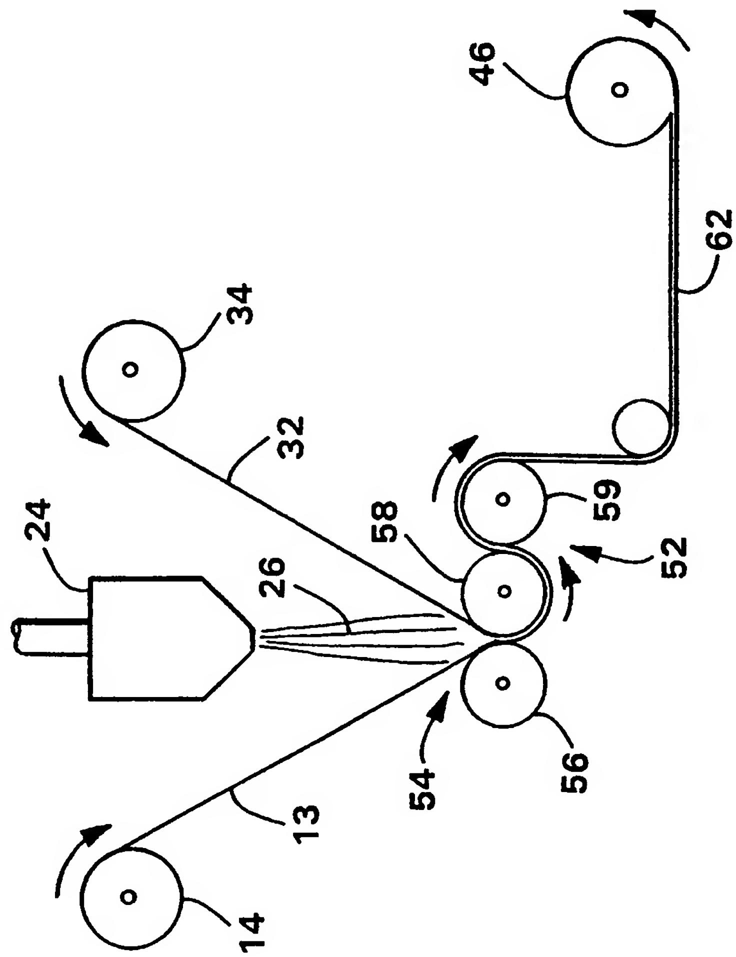
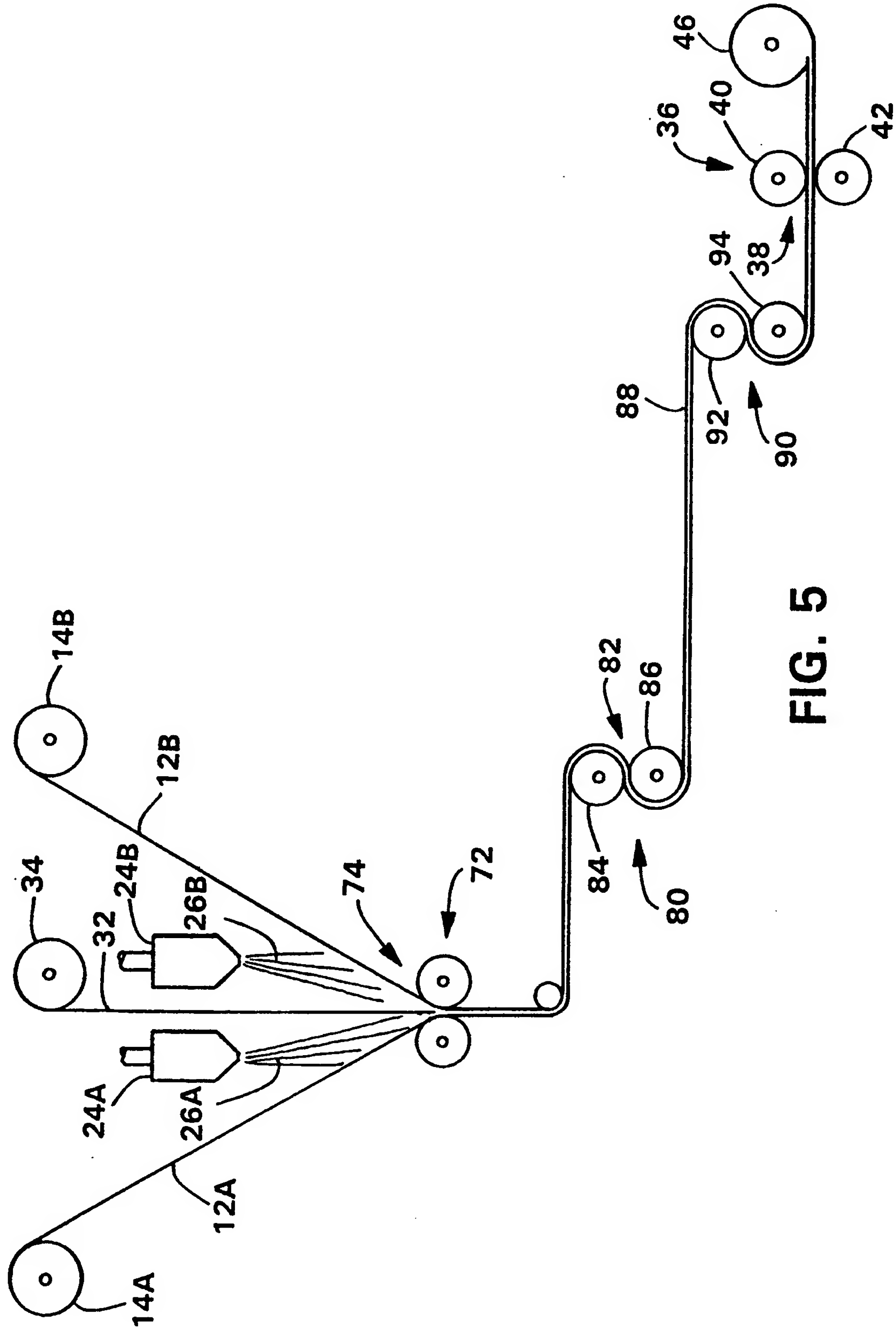


FIG. 4


14A
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26B
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FIG. 5

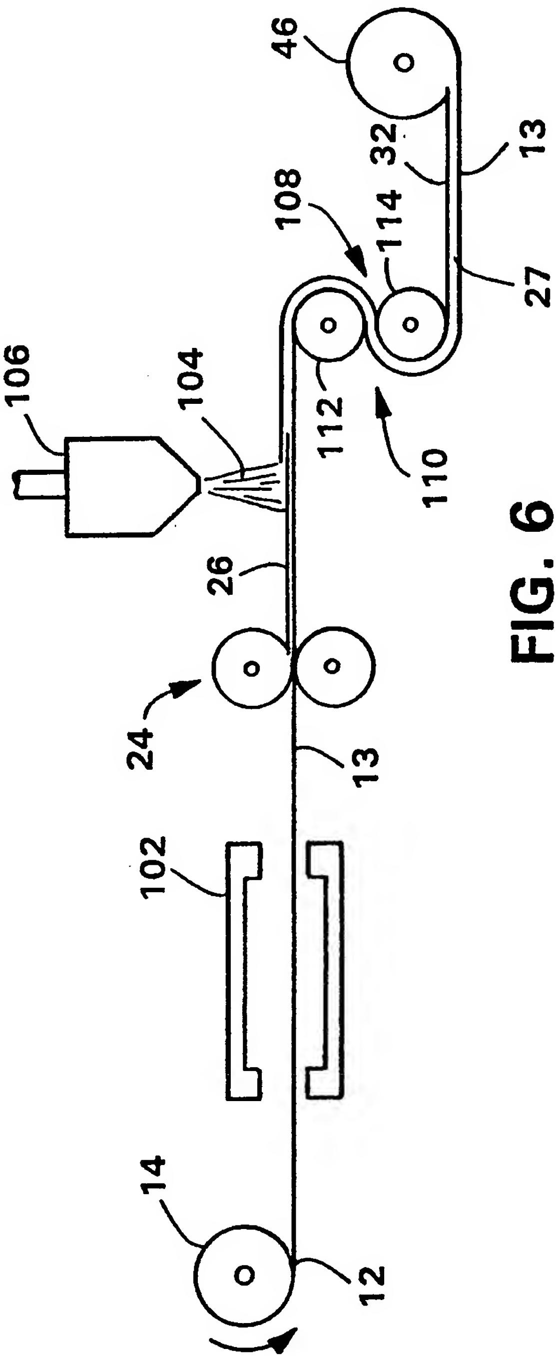

FIG. 6

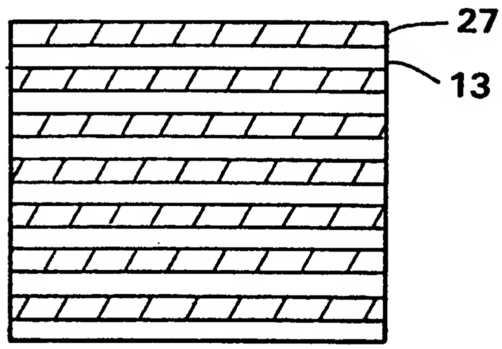

FIG. 7

INTERNATIONAL SEARCH REPORT

Inte· ·onal Application No
PCT/US 97/18561

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 D04H13/00 B32B5/04 B32B31/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 D04H A61F B32B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category '	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 981 747 A (MORMAN MICHAEL T) 1 January 1991 cited in the application see column 3, line 21 - line 43 see column 4, line 7 - line 11 ---	1,18-20, 23-25, 29-39
Y	GB 1 200 235 A (AB BILLINSFORS-LANGED) 29 July 1970 see page 2, line 11 - line 45 ---	1,18-20, 23-25, 29-39
A	EP 0 707 106 A (KIMBERLY CLARK CO) 17 April 1996 see page 3, line 40 - line 54 see page 5, line 11 - line 15 see page 6, line 58 - page 7, line 30 --- -/--	1,34,35

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

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Date of the actual completion of the international search	Date of mailing of the international search report
29 January 1998	13/02/1998
Name and mailing address of the ISA	**Authorized officer**
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Lanaspeze, J

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INTERNATIONAL SEARCH REPORT

Inte ional Application No
PCT/US 97/18561

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	WO 95 17302 A (KIMBERLY CLARK CO) 29 June 1995 see page 10, line 32 - page 11, line 11 see page 13, line 3 - line 9 see page 14, line 4 - line 19 see figure -----	1,34,35

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INTERNATIONAL SEARCH REPORT

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